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Aktau Plastics Plant Explosives Material Report

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Abstract

The U.S. Department of Energy (DOE) has been cooperating with the Republic of Kazakhstan in Combined Threat Reduction (CTR) activities at the BN350 reactor located at the Mangyshlak Atomic Energy Complex (MAEC) in the city of Aktau, Kazakhstan since 1994. DOE contract personnel have been stationed at this facility for the last two years and DOE representatives regularly visit this location to oversee the continuing cooperative activities. Continued future cooperation is planned. A Russian news report in September 1999 indicated that 75 metric tons of organic peroxides stored at the Plastics Plant near Aktau were in danger of exploding and killing or injuring nearby residents. To ensure the health and safety of the personnel at the BN350 site, the DOE conducted a study to investigate the potential danger to the BN350 site posed by these materials at the Plastics Plant. The study conclusion was that while the organic peroxides do have hazards associated with them, the BN350 site is a safe distance from the Plastics Plant. Further, because the Plastics Plant and MAEC have cooperative fire-fighting agreements, and the Plastics Plant had exhausted its reserve of fire-fighting foam, there was the possibility of the Plastics Plant depleting the store of fire-fighting foam at the BN350 site. Subsequently, the DOE decided to purchase fire-fighting foam for the Plastics Plant to ensure the availability of fire-fighting foam at the BN350 site.

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Acronyms

CTR	Cooperative Threat Reduction
DOE	U.S. Department of Energy
FBIS	Foreign Broadcast Information System
MAEC	Mangyshlak Atomic Energy Complex
MSDS	Material Safety Data Sheet
NAC	Nuclear Assurance Corporation, International
psig	pounds per square inch gauge

1. Introduction

The U.S. Department of Energy (DOE) has been cooperating with the Republic of Kazakhstan government under the auspices of the Cooperative Threat Reduction (CTR) program since 1995. One significant activity has been the cooperative activities at the BN350 reactor located at the Mangyshlak Atomic Energy Complex (MAEC) in the city of Aktau, Kazakhstan. DOE contract personnel have been stationed at this facility for the last two years and DOE representatives regularly visit this location to oversee the ongoing work. Continued future cooperation is planned during the BN350 fuel disposition project and U.S. efforts relating to the future safe decommissioning of the BN350 reactor.

Maintaining a good health and safety environment for both U.S. and Kazakh personnel has been an important focus of DOE efforts during these cooperative activities and one that DOE continues to consider crucial to future cooperative activities.

2. Background

The first indication of a potential problem (explosion and/or chemical contamination) that could pose a risk to U.S. personnel stationed at the BN350 Fast Breeder Reactor in Aktau, Kazakhstan, occurred in September 1999. The source of the information was a Foreign Broadcast Information System (FBIS) report distributed to the BN350 project team by John Franklin of Sandia National Laboratories. The FBIS document reported the following from a Russian television news show under the headline “Kazakh Town Under Threat From Chemical Storage Depot”:

“[Presenter] An emergency situation has been announced in Aktau [central town of Mangistau Region, on the Caspian Sea coast] on the territory of a plastics plant [in Russ-zavod plasticheskikh mass]. A total of 75 tonnes of toxic and explosively dangerous peroxide has been stored here. Specialists fear that the town might be blown up into the air. A total of 75 tonnes of organic peroxide which is stored in the Plastics Plant falls into the first most explosively dangerous category. The TNT equivalent of a possible explosion is 70 tonnes or a wagon full of explosives.”

“[Turlan Mukashev: (head of the department for ecological monitoring of the regional management of environment protection)] stated that: According to both calculations, well, by specialists from [word indistinct] and our calculations, the range of the explosion is from 5 to 15 km and the number of human casualties will be approximately up to about 15,000 people.”

“[Correspondent, over video of the plant’s territory and storehouse] The area of destruction will cover the nuclear power plant and plants of the chemical complex. In this case, the number of victims will reach 150,000 people. This is the entire population of Aktau town.”

“Organic peroxide is used as a raw material in the production of polystyrene. It was brought into the plant a few years ago. However, the rehabilitation of the plant, which was carried out in a mediocre fashion, led the enterprises to bankruptcy. The Aktau Plastics Plant joint-stock company has been standing idle for two years. The storage life of the peroxides has expired. Now they might spontaneously heat up and explode. Relative safety is being guaranteed only by maintaining the necessary parameters of humidity and temperature in the storehouses.”

The DOE decided that this information had potentially significant implications for the BN350 Fuel Disposition Project, and directed that additional information be obtained. During October 1999, several DOE laboratories gathered information and performed assessments to evaluate the validity of the FBIS report and the implications for the BN350 project. During October 1999, staff from DOE laboratories and Nuclear Assurance Corporation, International (NAC) (the on-site contractor) assessed the potential damage to the BN350 complex should an explosion occur at the Plastics Plant. They also investigated the potential for chemical contamination and dangerous fumes arising from a fire or explosion.

3. Assessment

3.1 Relative Locations of Facilities

The distance between the BN350 and the Plastics Plant is 6.1 km. The Plastics Plant is located inland and north-northwest of the BN350 complex; the BN350 site is located very near the shore of the Caspian Sea. Commercial imagery from an Indian remote sensing satellite is provided in Appendix A showing the relative locations of the city of Aktau, the BN350 and MAEC complex, and the Plastics Plant.

3.2 Materials

Assessment of the potential damage to structures and/or hazard to life at the BN350 site required determining (1) the specific materials involved, (2) the relative locations of the two facilities, and (3) the explosive and biological impact capabilities of the materials at the Plastics Plant.

Members of the project team from NAC and Argonne National Laboratory visited the factory. Previously, the factory produced polystyrene. Styrene monomer was catalyzed into the polystyrene form using organic peroxides, which are highly volatile materials. Approximately 75 metric tons of these catalysts are stored at the Plastics Plant.

The materials are three different organic chemicals; the amount of each chemical and name¹, as provided by the factory staff, are

1. 13.3 metric tons of “technical benzoyl peroxide” [**benzoyl peroxide**]
2. 45.8 metric tons of “tributylperbenzoate” [**tert-butyl peroxybenzoate; tert-butyl perbenzoate**]
3. 16.1 metric tons of “dicumyl peroxide” [**bis(1-methyl-1-phenylethyl) peroxide**]

3.2.1 Materials Toxicity

Copies of the Material Safety Data Sheets (MSDSs)² were obtained for the chemicals above, and circulated to the principals involved with this issue. Copies of these sheets are provided in Appendix B. In summary, the following information is extracted from these MSDS sheets concerning hazards and the toxicity of these three organic materials.

3.2.2 MSDS-Listed Toxicity

benzoyl peroxide

Potential health hazards include:

INHALATION:	irritation, low body temperature, and difficulty breathing
SKIN CONTACT:	irritation
EYE CONTACT:	irritation, watering eyes, and blurred vision
INGESTION:	nausea, vomiting, stomach pain, and reproductive effects

However, it is not a carcinogen, and when burned, the thermal decomposition products are oxides of carbon.

tert-butyl peroxybenzoate; or tert-butyl perbenzoate

Potential health hazards include:

INHALATION:	irritation, nausea, vomiting, and headache
SKIN CONTACT:	irritation
EYE CONTACT:	irritation
INGESTION:	no data available
LONG-TERM EXPOSURE:	no data on significant adverse effects

¹ Chemical name equivalents are provided in the parenthetical expressions.

² Material Safety Data Sheets (MSDSs) are designed to provide both workers and emergency personnel with the proper procedures for handling or working with that substance. They include information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill/leak procedures. A good Internet source of information on MSDSs may be found at <http://www.ilpi.com/msds/index.html#What>.

However, it is not a carcinogen, and the products from its burning include oxides of carbon. Care should be exercised to avoid contact with incompatible materials, which include acids, bases, oxidizing materials, and combustible materials. It is a polymerization initiator for polyethylene, polystyrene, polyacrylates, and polyesters.

dicumyl peroxide [bis(1-methyl-1-phenylethyl) peroxide]

Potential health hazards listed include those listed for the two compounds above, and, like them, it is not a carcinogen. However, it has more thermal decomposition products (e.g., oxides of carbon, ketones, alcohols, various organic fragments, hydrocarbon gases) than those of the other two chemicals. It does not polymerize.

4. Fire-Fighting Measures

The MSDSs also recommended a series of fire-fighting measures, as these materials could be especially hazardous in a fire situation. A summary of these recommended fire-fighting measures for these three chemicals follows.

4.1 Hazards

All three materials present a severe fire and explosion hazard and are organic peroxides. They are flammable and increase their rate of burning as a fire progresses. They may ignite or explode on contact with combustible materials, and containers may rupture or explode if exposed to heat with these chemicals in them.

4.2 Extinguishing Media

Use regular dry chemical, carbon dioxide, water, or regular foam. For large fires, flood them with water and apply water from a protected location or from a safe distance.

4.3 Fire Fighting

- Cool containers with water from an unmanned hose holder and then monitor the nozzles until well after the fire is out. If this is impossible, keep unnecessary people away by isolating the hazard area and denying entry. For a tank, rail car, or tank truck, a safe evacuation radius is 800 meters (1/2 mile).
- Let the fire burn.
- Flood the fire (if possible) with a fine water spray. Apply water from a protected location or from a safe distance.
- Do not scatter spilled material with high-pressure water streams.
- Cool containers with water spray until well after the fire is out.

4.4 Chemical Toxicity Hazard Summary

In summary, these materials present a significant explosive and fire risk, and should not be ingested or inhaled, but do not seem to present a significant risk to workers at the BN350 plant. Combustion products are not carcinogenic, and with the proper use of fire-retardant materials and fire-fighting techniques, the hazard from these materials for personnel at the BN350 appears small.

5. Explosive Capabilities/Effects of Materials

A DOE safety expert, Dr. Peter Pelto,³ assessed the maximum damage that could result from the explosion of the entire 75 metric tons of organic peroxide materials at the Plastics Plant. He conservatively assumed that the total inventory of organic peroxides (75.2 metric tons) is equivalent to an equal quantity of TNT, and concluded

“Based upon the very conservative analysis performed using the TNT model, no damage would be expected to occur to the BN350 Reactor Complex as a result of an explosion at the Plastics Plant. The Reactor Complex is located approximately 6.1 km from the Plastics Plant. This distance is well beyond the “Safe Distance” of 1.5 km. The potential impact to the Plastics Plant and any directly adjacent facilities is large but any damage to the BN350 Reactor Complex is expected to be minimal.”⁴

A complete copy of his analysis is provided at Appendix C. In summary, no significant explosive danger exists to the BN350 complex from the Plastics Plant.

5.1 Related Safety Issue(s)

However, there are possible future issues if this material is not disposed of or removed from the Aktau area before next summer. This material is sensitive to temperature, and becomes more sensitive as time passes. This could be a significant problem if air conditioning is not available when needed next spring and summer.

A second issue relates to the potential interaction between the Plastics Plant and the BN350 site. This possible interaction concerns supplies available at the fire departments at the two facilities. Should a fire occur at the Plastics Plant, fire-fighting foam is the material of choice to minimize damage and minimize involvement. However, the Plastics Plant has no funds to replenish their foam supply, which they exhausted while fighting a recent fire in which an employee died. In the event of a serious incident, it is very likely that the fire-fighting capabilities of the BN350 fire department would be called into action, and foam from their supply would be used. This would

³ Dr. Pelto is an employee of the DOE's Pacific Northwest National Laboratory.

⁴ “Safe Distance” is the distance at which the peak overpressure has fallen to 0.3 psig (pounds per square inch gauge), which is the distance at which no serious injuries would be expected.

deplete the BN350 supply and leave the reactor complex with a diminished fire-fighting capability if an incident requiring the use of foam occurs. As a result, DOE has decided to provide a limited amount of fire-fighting foam directly to the Plastics Plant fire department.

6. Summary

This analysis indicates that there is no explosive or toxicity hazard to the BN350. However, the explosive analysis and the chemical MSDSs indicate that these materials should be taken very seriously. With appropriate care, they do not pose a problem to workers or U.S. personnel at the BN350. Providing a quantity of fire-fighting foam to the Plastics Plant will further assist in providing a safe working environment for U.S. personnel stationed at the BN350 facility.

Appendix A

Aktau, Kazakhstan, and Surrounding Area

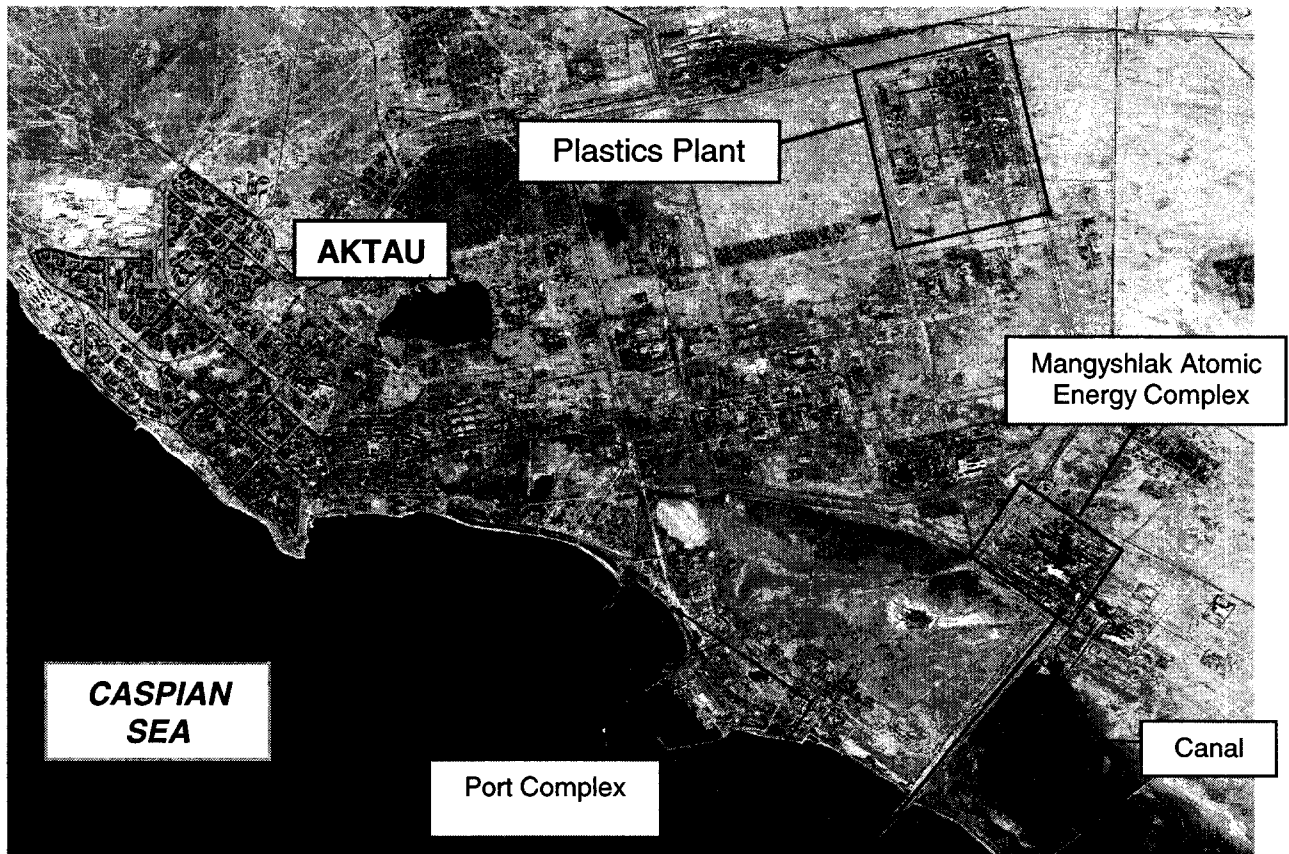
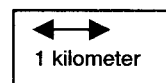


Image Source: Indian Remote Sensing Satellite (IRS) 1-D



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Appendix B

MSDS for Organic Peroxides Present at Aktau Plastics Plant:

Benzoyl Peroxide

**Tert-Butyl Peroxybenzoate
(Tert-Butyl Perbenzoate)**

**Dicumyl Peroxide
Bis(1-Methyl-1-Phenylethyl) Peroxide**

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MATERIAL SAFETY DATA SHEET

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: BENZOYL PEROXIDE

TRADE NAMES/SYNONYMS:

PEROXIDE, DIBENZOYL; BENOXYL; BENZOPEROXIDE; BENZOYL SUPEROXIDE;
DIPHENYLGLYOXAL PEROXIDE; DIBENZOYL PEROXIDE; NA 2085; STCC 4919110;
C14H10O4; OHS02780; RTECS DM8575000

CHEMICAL FAMILY: organic peroxides

CREATION DATE: Sep 14 1984

REVISION DATE: Mar 09 1999

SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: BENZOYL PEROXIDE

CAS NUMBER: 94-36-0

EC NUMBER (EINECS): 202-327-6

PERCENTAGE: <99

COMPONENT: WATER

CAS NUMBER: 7732-18-5

EC NUMBER (EINECS): 231-791-2

PERCENTAGE: >1

SECTION 3 HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=4 REACTIVITY=4

EC CLASSIFICATION (ASSIGNED):

E Explosive

O Oxidizing

Xi Irritant

Sensitizing

R 2-7-36-43

EC Classification may be inconsistent with independently-researched data.

EMERGENCY OVERVIEW:

COLOR: colorless to white

PHYSICAL FORM: crystals, granules

ODOR: almond odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation

PHYSICAL HAZARDS: May explode if exposed to shock, friction or heating. Flammable solid. Organic peroxide. May ignite or explode on contact with combustible materials.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, low body temperature, difficulty breathing

LONG TERM EXPOSURE: no information is available

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: same as effects reported in short term exposure

EYE CONTACT:

SHORT TERM EXPOSURE: irritation, tearing, blurred vision

LONG TERM EXPOSURE: same as effects reported in short term exposure

INGESTION:

SHORT TERM EXPOSURE: nausea, vomiting, stomach pain

LONG TERM EXPOSURE: reproductive effects

CARCINOGEN STATUS:

OSHA: N

NTP: N

IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION: Remove from exposure immediately. Use a bag valve mask or similar device to perform artificial respiration (rescue breathing) if needed. Get medical attention.

SKIN CONTACT: Remove contaminated clothing, jewelry, and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention, if needed.

EYE CONTACT: Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains. Get medical attention immediately.

INGESTION: Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

NOTE TO PHYSICIAN: For ingestion, consider gastric lavage and activated charcoal slurry.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Severe explosion hazard. Organic peroxide. Flammable. Burns faster as the fire progresses. May ignite or explode on contact with combustible materials. Containers may rupture or explode if exposed to heat.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Flood with water. Apply water from a protected location or from a safe distance.

FIRE FIGHTING: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile). Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Explosive. Evacuation radius: 800 meters (1/2 mile).

AUTOIGNITION: 176 F (80 C)

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Small spills: Absorb with sand or other non-combustible material. Use non-sparking tools and equipment. Move containers away from spill to a safe area. Large spills: Wet down area with water. Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry.

SECTION 7 HANDLING AND STORAGE

Store and handle in accordance with all current regulations and standards. Keep separated from incompatible substances. NFPA 430 Code for the Storage of Liquid and Solid Oxidizing Materials. Protect from physical damage. Store and handle in a detached building. Keep separated from incompatible substances. Store in a cool, dry place. Store in a well-ventilated area. Use explosion-resistant electrical equipment. Store in original container. Store in a cool, dry place. Keep in the dark.

SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

BENZOYL PEROXIDE:

5 mg/m³ OSHA TWA

5 mg/m³ ACGIH TWA

5 mg/m³ NIOSH recommended TWA

5 mg/m³ DFG MAK 1 times/shift (total dust)

5 mg/m³ UK OES TWA

MEASUREMENT METHOD: Particulate filter; Diethyl ether; High-pressure liquid chromatography with ultraviolet detection; NIOSH III # 5009

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

50 mg/m³

Any dust and mist respirator.

Any supplied-air respirator.

Any self-contained breathing apparatus.

125 mg/m³

Any supplied-air respirator.

Any powered, air-purifying respirator with a dust and mist filter.

250 mg/m³

Any air-purifying respirator with a full facepiece and a high-efficiency particulate filter.

Any powered, air-purifying respirator with a full facepiece and a high-efficiency particulate filter.

Any self-contained breathing apparatus with a full facepiece.

Any supplied-air respirator with a full facepiece.

1500 mg/m³

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

Escape -

Any air-purifying respirator with a full facepiece and a high-efficiency particulate filter.

Any appropriate escape-type, self-contained breathing apparatus.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: solid

COLOR: colorless to white

PHYSICAL FORM: crystals, granules

ODOR: almond odor

MOLECULAR WEIGHT: 242.23

MOLECULAR FORMULA: C₆H₅-C-(O)-O-O-C-(O)-C₆H₅

BOILING POINT: Not applicable

MELTING POINT: Not available

DECOMPOSITION POINT: 223-226 F (106-108 C) (explodes)

VAPOR PRESSURE: 1 mmHg @ 20C

VAPOR DENSITY: Not applicable

SPECIFIC GRAVITY (water=1): 1.3340 @ 25 C

WATER SOLUBILITY: <1%

PH: Not applicable

VOLATILITY: Not applicable

ODOR THRESHOLD: Not available

EVAPORATION RATE: Not applicable

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: benzene, ether, acetone, chloroform

Slightly Soluble: alcohol, carbon disulfide, olive oil

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: May decompose explosively when heated above 106 C. May explode if exposed to shock, friction or heating.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Avoid friction or contamination. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: acids, combustible materials, amines, reducing agents

BENZOYL PEROXIDE:

ACIDS (ORGANIC OR INORGANIC): Violent reaction.

ACIDS + VINYL COMPOUNDS: May initiate exothermic polymerization.

ALCOHOLS: Violent reaction.

ALLYL COMPOUNDS: May initiate exothermic polymerization.

AMINES: Violent reaction.

ANILINE: Mixture leads to mildly explosive decomposition.

N-BROMOSUCCINIMIDE, P-TOLUIC ACID: Violently explosive.

CARBON TETRACHLORIDE AND ETHYLENE: Explosive reaction.

CHARCOAL: Violent reaction when heated above 50 C.

N,N-DIMETHYLANILINE: Explosive on contact.

DIMETHYL SULFIDE: Explosive decomposition.

LITHIUM ALUMINUM HYDRIDE: Violently explosive.

METALLIC NAPHTHENATES: Violent reaction.

METHYL METHACRYLATE: Initiates violent, exothermic polymerization.

ORGANIC MATERIALS: Explosive reaction.

PLASTICS, RUBBERS AND COATINGS: May be attacked and may result in fire and explosion.

REDUCING AGENTS: Fire and explosion hazard.

VINYL ACETATE: Initiates violent, exothermic polymerization.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

SECTION 11 TOXICOLOGICAL INFORMATION

BENZOYL PEROXIDE:

IRRITATION DATA:

500 mg/24 hour(s) eyes-rabbit mild

TOXICITY DATA:

2126 mg/kg oral-mouse LD50; 372 mg/kg intraperitoneal-rat LD50; 7710 mg/kg oral-rat LD50; 5700 mg/kg oral-mouse LD50; 250 mg/kg intraperitoneal-mouse LD50; >1 gm/kg skin-mammal LD50

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Inadequate Evidence, Group 3; ACGIH: A4 -Not Classifiable as a Human Carcinogen

Two studies indicated that benzoyl peroxide has tumor promoting activity in mouse skin.

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Slightly Toxic: ingestion

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: respiratory disorders, skin disorders and allergies

TUMORIGENIC DATA:

24 gm/kg skin-mouse TDLo/30 week(s) intermittent

MUTAGENIC DATA:

DNA repair - Escherichia coli 250 ug/well; DNA damage - human other cell types 100 umol/L; DNA inhibition - human other cell types 56 umol/L; other mutation test systems - human other cell types 56 umol/L; mutation in mammalian somatic cells - human kidney 300 umol/L; unscheduled DNA synthesis - rat liver 100 pmol/L; DNA damage - mouse other cell types 1 umol/L

ADDITIONAL DATA: May cross react with similar compounds.

Liver and kidney damage have been reported.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

BENZOYL PEROXIDE: Workers exposed to 12 mg/m³ experienced pronounced irritation of the nose and throat. Inhalation may also cause cough, dyspnea, decreased pulse rate, hypothermia, and stupor. In rats, 24,300 mg/m³ of 78% benzoyl peroxide for 4 hours caused eye squint, difficult breathing, salivation, and an increase followed by a decrease in motor activity.

CHRONIC EXPOSURE:

BENZOYL PEROXIDE: No data available.

SKIN CONTACT:

ACUTE EXPOSURE:

BENZOYL PEROXIDE: Direct contact may cause irritation with a transient burning or stinging sensation, redness, swelling and pain. Vasodilation and perivascular lymphocytic infiltration may occur. Sensitization dermatitis may occur in previously exposed individuals. A single application of 20-40 mg to mouse skin induced marked hyperplasia and temporary increase in the number of dark, basal keratinocytes.

CHRONIC EXPOSURE:

BENZOYL PEROXIDE: Repeated or prolonged exposure may cause excessive dryness with marked peeling, erythema, edema, and sensitization or contact dermatitis.

EYE CONTACT:

ACUTE EXPOSURE:

BENZOYL PEROXIDE: Direct contact may cause irritation with redness, pain and blurred vision. Vapors caused lacrimation in animals. One report indicates that application to animal eyes produced superficial corneal opacities and conjunctivitis.

CHRONIC EXPOSURE:

BENZOYL PEROXIDE: Repeated or prolonged exposure to irritants may cause conjunctivitis.

INGESTION:

ACUTE EXPOSURE:

BENZOYL PEROXIDE: May cause abdominal pain, nausea and vomiting. In mice and rats acute toxicity was characterized by motor disturbances, restlessness, generalized inhibition, and respiratory difficulties. No deaths or symptoms were reported in rats fed 5000 mg/kg of a 78% benzoyl peroxide solution.

CHRONIC EXPOSURE:

BENZOYL PEROXIDE: Rats fed 2800 mg/kg in the diet showed an increased incidence of testicular atrophy.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 20000 ug/L 0.033 day(s) (Behavior) Aholehole (*Kuhlia sandvicensis*)

SECTION 13 DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. D003. Dispose in accordance with all applicable regulations.

SECTION 14 TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101 SHIPPING NAME-UN NUMBER:

Organic peroxide type B, solid (dibenzoyl peroxide <99%)-UN3102

U.S. DOT 49 CFR 172.101 HAZARD CLASS OR DIVISION:

5.2

U.S. DOT 49 CFR 172.101 PACKING GROUP:

II

U.S. DOT 49 CFR 172.101 AND SUBPART E LABELING REQUIREMENTS:

Organic peroxide; Explosive

U.S. DOT 49 CFR 172.101 PACKAGING AUTHORIZATIONS:

EXCEPTIONS: 49 CFR 173.152

NON-BULK PACKAGING: 49 CFR 173.225

BULK PACKAGING: None

U.S. DOT 49 CFR 172.101 QUANTITY LIMITATIONS:

PASSENGER AIRCRAFT OR RAILCAR: Forbidden

CARGO AIRCRAFT ONLY: Forbidden

LAND TRANSPORT ADR/RID:

SUBSTANCE NAME: Organic peroxide type B, solid

UN NUMBER: UN3102

ADR/RID CLASS: 5.2

ITEM NUMBER: 2(b)

WARNING SIGN/LABEL: 5.2; 01

HAZARD ID NUMBER: 539

AIR TRANSPORT IATA/ICAO:

CORRECT TECHNICAL NAME: Organic peroxide type B, solid

UN/ID NUMBER: UN3102

IATA/ICAO CLASS: 5.2

MARITIME TRANSPORT IMDG:

CORRECT TECHNICAL NAME: Organic peroxide type B, solid

UN/ID NUMBER: UN3102

IMDG CLASS: 5.2

PACKAGING GROUP: II

EmS No.: 5.2-01

MFAG Table No.: 735

MARINE POLLUTANT: N

SECTION 15 REGULATORY INFORMATION

U.S. REGULATIONS:

TSCA INVENTORY STATUS: Y

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CERCLA SECTION 103 (40CFR302.4): N

SARA SECTION 302 (40CFR355.30): N

SARA SECTION 304 (40CFR355.40): N

SARA SECTION 313 (40CFR372.65): Y

BENZOYL PEROXIDE

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40CFR370.21):

ACUTE: Y

CHRONIC: N

FIRE: Y

REACTIVE: Y

SUDDEN RELEASE: Y

OSHA PROCESS SAFETY (29CFR1910.119): Y

BENZOYL PEROXIDE: 7500 LBS TQ

STATE REGULATIONS:

California Proposition 65: N

EUROPEAN REGULATIONS:

EC NUMBER (EINECS): 202-327-6

EC RISK AND SAFETY PHRASES:

R 2	Risk of explosion by shock, friction, fire or other sources of ignition.
R 7	May cause fire.
R 36	Irritating to eyes.
R 43	May cause sensitization by skin contact.
S 2	Keep out of reach of children.
S 3/7	Keep container tightly closed in a cool place.
S 14	Keep away from incompatible materials.
S 36/37/39	Wear suitable protective clothing, gloves and eye/face protection.

GERMAN REGULATIONS:

WATER HAZARD CLASS (WGK): 1 (Official German Classification)

SECTION 16 OTHER INFORMATION

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MATERIAL SAFETY DATA SHEET

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: TERT-BUTYL PEROXYBENZOATE

TRADE NAMES/SYNONYMS:

T-BUTYL PERBENZOATE; T-BUTYLPEROXYBENZOATE; ESPEROX(R) 10;
TRIGONOX(R) C; KAYABUTYL B; LUPEROX P; PERBUTYL Z;
BENZENECARBOPEROXOIC ACID, 1,1-DIMETHYLETHYL ESTER; PEROXYBENZOIC
ACID, TERT-BUTYL ESTER; BENZOYL TERT-BUTYL PEROXIDE;
1,1-DIMETHYLETHYL ESTER OF BENZENECARBOPEROXOIC ACID; TERT-BUTYL
BENZOYL PEROXIDE; TERT-BUTYL PERBENZOATE; T-BP; UN3103; C11H14O3;
OHS22730; RTECS SD9450000

CHEMICAL FAMILY: aromatic, organic peroxides

CREATION DATE: Jul 09 1986

REVISION DATE: Mar 09 1999

SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: TERT-BUTYL PEROXYBENZOATE

CAS NUMBER: 614-45-9

EC NUMBER (EINECS): 210-382-2

PERCENTAGE: >98

SECTION 3 HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=3

EC CLASSIFICATION (CALCULATED):

O Oxidizing

F Highly Flammable

Xn Harmful

R 7-11-22-36-44

EMERGENCY OVERVIEW:

COLOR: colorless to yellow

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: No significant target effects reported.

PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire. Organic peroxide. May ignite or explode on contact with combustible materials. May explode if heated in closed container.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, nausea, vomiting, headache

LONG TERM EXPOSURE: no information is available

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: no information is available

EYE CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: no information is available

INGESTION:

SHORT TERM EXPOSURE: no information is available

LONG TERM EXPOSURE: no information on significant adverse effects

CARCINOGEN STATUS:

OSHA: N

NTP: N

IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION: Remove from exposure immediately. Use a bag valve mask or similar device to perform artificial respiration (rescue breathing) if needed. Get medical attention.

SKIN CONTACT: Remove contaminated clothing, jewelry, and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention, if needed.

EYE CONTACT: Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains. Get medical attention immediately.

INGESTION: If vomiting occurs, keep head lower than hips to help prevent aspiration. Get medical attention, if needed.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Vapor/air mixtures are explosive. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Containers may rupture or explode if exposed to heat. Organic peroxide.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Flood with water. Apply water from a protected location or from a safe distance.

FIRE FIGHTING: Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn.

FLASH POINT: 66 F (19 C)

FLAMMABILITY CLASS (OSHA): IB

HAZARDOUS COMBUSTION PRODUCTS:

Thermal decomposition products or combustion: oxides of carbon

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Small spills: Absorb with sand or other non-combustible material. Move containers away from spill to a safe area. Large spills: Wet down area with water. Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry.

SECTION 7 HANDLING AND STORAGE

Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store and handle in a detached building. Store in a well-ventilated area. Store between 10 C and 27 C. Keep separated from incompatible substances. Avoid heat, flames, sparks and other sources of ignition. Deluge sprinkler system required in storage area. NFPA 43B Standard for Storage of Organic Peroxide Formulations. Grounding and bonding required. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Store in a tightly closed container.

SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

TERT-BUTYL PEROXYBENZOATE:

No occupational exposure limits established.

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

PROTECTIVE MATERIAL TYPES: butyl rubber, neoprene, polyvinyl chloride (PVC)

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

Any chemical cartridge respirator with organic vapor cartridge(s).

Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and an organic vapor canister.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

COLOR: colorless to yellow

ODOR: distinct odor

MOLECULAR WEIGHT: 194.25

MOLECULAR FORMULA: (C-H3)3-C-O-O-O-C-C6-H5

BOILING POINT: 167-169 F (75-76 C) @ 0.2 mmHg

FREEZING POINT: 43-48 F (6-9 C)

DECOMPOSITION POINT: 234 F (112 C)

VAPOR PRESSURE: 0.33 mmHg @ 50 C

VAPOR DENSITY (air=1): 6.7

SPECIFIC GRAVITY (water=1): 1.021-1.04

WATER SOLUBILITY: insoluble

PH: Not available

VOLATILITY: 100% by volume

ODOR THRESHOLD: Not available

EVAPORATION RATE: Not available

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: alcohols, esters, ketones, acetone, ether, organic solvents

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: May explode if heated in closed container.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Avoid contact with incompatible materials. Keep out of water supplies and sewers.

INCOMPATIBILITIES: acids, bases, oxidizing materials, combustible materials

TERT-BUTYL PEROXYBENZOATE:

ACIDS (STRONG): Incompatible.

ALIPHATIC ETHERS: Reacts.

ALIPHATIC OLEFINS: Reacts.

BASES (STRONG): Incompatible.

COMBUSTIBLE MATERIAL: May react.

COMPOUNDS CONTAINING AN ACTIVATED HYDROGEN: Reacts.

COPPER(I) BROMIDE + LIMONENE: Explosive reaction.

CYCLIC ETHERS: Reacts.

CYCLIC OLEFINS: Reacts.

OXIDIZING MATERIAL: May react.

ORGANIC MATERIAL: Ignites or explodes on contact.

REDUCING AGENTS: Incompatible.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products or combustion: oxides of carbon

POLYMERIZATION: Polymerization initiator for polyethylene, polystyrene, polyacrylates and polyesters.

SECTION 11 TOXICOLOGICAL INFORMATION

TERT-BUTYL PEROXYBENZOATE:

IRRITATION DATA:

500 mg/24 hour(s) skin-rabbit mild; 100 mg/1 minute(s) rinsed eyes-rabbit mild; 500 mg/24 hour(s) eyes-rabbit mild

TOXICITY DATA:

1012 mg/kg oral-rat LD50; >57 mg/m³/4 hour(s) inhalation-rat LC; 914 mg/kg oral-mouse LD50; >57 mg/m³/4 hour(s) inhalation-mouse LC; 32500 mg/kg/13 week(s) intermittent oral-rat TDLo; 6 mg/m³/4 hour(s) inhalation-rat TCLo; 32500 mg/kg/13 week(s) intermittent oral-mouse TDLo

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

TUMORIGENIC DATA:

311 mg/kg unreported-mouse TDLo

MUTAGENIC DATA:

mutation in microorganisms - Salmonella typhimurium 67 ug/plate (-S9)

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: May cause irritation to the throat, mucous membranes and upper respiratory tract. Vapors may cause headache, nausea and vomiting.

CHRONIC EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: No data available.

SKIN CONTACT:

ACUTE EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: May cause mild irritation.

CHRONIC EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: No data available.

EYE CONTACT:

ACUTE EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: May cause mild irritation. This chemical when tested as a 50% solution in dimethyl phthalate applied to rabbit eyes caused slight injury, graded 1 on a scale of 0 to 7.

CHRONIC EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: No data available.

INGESTION:

ACUTE EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: No data available.

CHRONIC EXPOSURE:

TERT-BUTYL PEROXYBENZOATE: In animal studies, doses up to 500 mg/kg resulted in reduced body weight gains and dose-dependent increases in forestomach weights and hyperplasia of the forestomach mucosa. The No Observed Adverse Effect Level is thought to be approximately 30 mg/kg.

SECTION 12 ECOLOGICAL INFORMATION

Not available

SECTION 13 DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. D003.

SECTION 14 TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101 SHIPPING NAME-UN NUMBER:

Organic peroxide type C, liquid (TERT-BUTYL PEROXYBENZOATE)-UN3103

U.S. DOT 49 CFR 172.101 HAZARD CLASS OR DIVISION:

5.2

U.S. DOT 49 CFR 172.101 PACKING GROUP:

II

U.S. DOT 49 CFR 172.101 AND SUBPART E LABELING REQUIREMENTS:

Organic peroxide

U.S. DOT 49 CFR 172.101 PACKAGING AUTHORIZATIONS:

EXCEPTIONS: 49 CFR 173.152

NON-BULK PACKAGING: 49 CFR 173.225

BULK PACKAGING: None

U.S. DOT 49 CFR 172.101 QUANTITY LIMITATIONS:

PASSENGER AIRCRAFT OR RAILCAR: 5 L

CARGO AIRCRAFT ONLY: 10 L

LAND TRANSPORT ADR/RID:

SUBSTANCE NAME: Organic peroxide type C, liquid

UN NUMBER: UN3103

ADR/RID CLASS: 5.2

ITEM NUMBER: 3(b)

WARNING SIGN/LABEL: 5.2; 8

HAZARD ID NUMBER: 539

AIR TRANSPORT IATA/ICAO:

CORRECT TECHNICAL NAME: Organic peroxide type C, liquid

UN/ID NUMBER: UN3103

IATA/ICAO CLASS: 5.2

LABEL: Organic peroxide

MARITIME TRANSPORT IMDG:

CORRECT TECHNICAL NAME: Organic peroxide type C, liquid

UN/ID NUMBER: UN3103

IMDG CLASS: 5.2

PACKAGING GROUP: II

EmS No.: 5.2-01

MFAG Table No.: 735

MARINE POLLUTANT: N

SECTION 15 REGULATORY INFORMATION

U.S. REGULATIONS:

TSCA INVENTORY STATUS: Y

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CERCLA SECTION 103 (40CFR302.4): N

SARA SECTION 302 (40CFR355.30): N

SARA SECTION 304 (40CFR355.40): N

SARA SECTION 313 (40CFR372.65): N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40CFR370.21):

ACUTE: N

CHRONIC: N

FIRE: Y

REACTIVE: Y

SUDDEN RELEASE: Y

OSHA PROCESS SAFETY (29CFR1910.119): Y

TERT-BUTYL PEROXYBENZOATE: 7500 LBS TQ

STATE REGULATIONS:

California Proposition 65: N

EUROPEAN REGULATIONS:

EC NUMBER (EINECS): 210-382-2

EC RISK AND SAFETY PHRASES:

R 7	May cause fire.
R 11	Highly flammable.
R 22	Harmful if swallowed.
R 36	Irritating to eyes.
R 44	Risk of explosion if heated under confinement.
S 2	Keep out of reach of children.
S 13	Keep away from food, drink and animal feeding stuffs.
S 24	Avoid contact with skin.
S 26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 36	Wear suitable protective clothing.
S 46	If swallowed, seek medical advice immediately and show this container or label.

GERMAN REGULATIONS:

WATER HAZARD CLASS (WGK): 2 (Official German Classification)

SECTION 16 OTHER INFORMATION

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MATERIAL SAFETY DATA SHEET

SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000

EMERGENCY TELEPHONE NUMBER
1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: DICUMYL PEROXIDE

TRADE NAMES/SYNONYMS:

ACTIVE DICUMYL PEROXIDE; CUMENE PEROXIDE; PEROXIDE, BIS(1-METHYL-1-PHENYLETHYL); BIS(ALPHA,ALPHA-DIMETHYLBENZYL) PEROXIDE; DI-ALPHA-CUMYL PEROXIDE; DIISOPROPYL BENZENE PEROXIDE; ISOPROPYL BENZENE PEROXIDE; CUMYL PEROXIDE; DICUMENE HYDROPEROXIDE; DICUMENYL PEROXIDE; DCP; DI-CUP; LUPEROX 500R (PENNWALT CHEMICAL AND EQUIPMENT); VAROX DCP-R; IMPCO HI-TEMP CATALYST; UN 2121; STCC 4919540; OHS07020; RTECS SD8150000

CHEMICAL FAMILY: organic peroxides

CREATION DATE: Feb 14 1985

REVISION DATE: Mar 09 1999

SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: DICUMYL PEROXIDE

CAS NUMBER: 80-43-3

EC NUMBER (EINECS): 201-279-3

EC INDEX NUMBER: 617-006-00-X

PERCENTAGE: >99

OTHER CONTAMINANTS:

MAY CONTAIN CUMENE HYDROPEROXIDE AND TRACES OF DECOMPOSITION PRODUCTS

SECTION 3 HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=0 FIRE=1 REACTIVITY=2

EC CLASSIFICATION (ASSIGNED):

O Oxidizing

Xi Irritant

R 7-36/38

EC Classification may be inconsistent with independently-researched data.

EMERGENCY OVERVIEW:

COLOR: white to yellow

PHYSICAL FORM: crystals, solid

ODOR: fruity odor

MAJOR HEALTH HAZARDS: No significant target effects reported.

PHYSICAL HAZARDS: Organic peroxide. May ignite or explode on contact with combustible materials. May decompose with evolution of heat.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: no information on significant adverse effects

LONG TERM EXPOSURE: no information is available

SKIN CONTACT:

SHORT TERM EXPOSURE: mild irritation

LONG TERM EXPOSURE: no information is available

EYE CONTACT:

SHORT TERM EXPOSURE: no information on significant adverse effects

LONG TERM EXPOSURE: no information is available

INGESTION:

SHORT TERM EXPOSURE: no information on significant adverse effects

LONG TERM EXPOSURE: no information is available

CARCINOGEN STATUS:

OSHA: N

NTP: N

IARC: N

SECTION 4 FIRST AID MEASURES

INHALATION: Remove from exposure immediately. Use a bag valve mask or similar device to perform artificial respiration (rescue breathing) if needed. Get medical attention.

SKIN CONTACT: Remove contaminated clothing, jewelry, and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention, if needed.

EYE CONTACT: Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains. Get medical attention immediately.

INGESTION: Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. Give large amounts of water. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Severe explosion hazard. Organic peroxide. Flammable. Burns faster as the fire progresses. May ignite or explode on contact with combustible materials. Containers may rupture or explode if exposed to heat.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Flood with water. Apply water from a protected location or from a safe distance.

FIRE FIGHTING: Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn.

FLASH POINT: 261 F (127 C) (CC)

SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Small spills: Absorb with sand or other non-combustible material. Move containers away from spill to a safe area. Large spills: Wet down area with water. Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry.

SECTION 7 HANDLING AND STORAGE

Store and handle in accordance with all current regulations and standards. Keep separated from incompatible substances.

SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

DICUMYL PEROXIDE:

No occupational exposure limits established.

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

Any chemical cartridge respirator with organic vapor cartridge(s) and dust and mist filter(s).

Any chemical cartridge respirator with organic vapor cartridge(s) and high-efficiency particulate filter(s).

Any air-purifying respirator with a full facepiece, an organic vapor canister and a dust, mist, and fume filter.

Any powered, air-purifying respirator with a full facepiece and a high-efficiency particulate filter.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: solid

COLOR: white to yellow

PHYSICAL FORM: crystals, solid

ODOR: fruity odor

MOLECULAR WEIGHT: 270.40

MOLECULAR FORMULA: C₁₈H₂₂O₂

BOILING POINT: decomposes

MELTING POINT: 100 F (38 C)

VAPOR PRESSURE: 15.4 mmHg @ 38 C

VAPOR DENSITY (air=1): 9.3

SPECIFIC GRAVITY (water=1): 1.02

WATER SOLUBILITY: insoluble

PH: Not applicable

VOLATILITY: Not applicable

ODOR THRESHOLD: Not available

EVAPORATION RATE: <1 butylacetate=1

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: vegetable oils, organic solvents, natural & synthetic rubbers, polyester resins

SECTION 10 STABILITY AND REACTIVITY

REACTIVITY: May decompose with evolution of heat above 55 C.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Avoid contact with incompatible materials. Keep out of water supplies and sewers.

INCOMPATIBILITIES: acids, metals, oxidizing materials, reducing agents

DICUMYL PEROXIDE:

ACIDS, ACIDIC-TYPE MATERIALS: Exothermic reaction.

IRON: Exothermic reaction.

LEAD: Exothermic reaction.

OXIDATION CATALYSTS: Exothermic reaction.

OXIDIZERS (STRONG): Exothermic reaction.

REDUCERS (STRONG): Exothermic reaction.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon, ketones, alcohols, various organic fragments, hydrocarbon gases

POLYMERIZATION: Will not polymerize.

SECTION 11 TOXICOLOGICAL INFORMATION

DICUMYL PEROXIDE:

TOXICITY DATA:

4100 mg/kg oral-rat LD50; 3500 mg/kg unreported-rat LD50

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

DICUMYL PEROXIDE: Animals have been exposed to 21-224 mg/m³ of 40% dicumyl peroxide absorbed on calcium carbonate for 6 hours without observable signs of toxicity. Decomposition products may result in mucous membrane irritation.

CHRONIC EXPOSURE:

DICUMYL PEROXIDE: No data available.

SKIN CONTACT:

ACUTE EXPOSURE:

DICUMYL PEROXIDE: Human and animal studies indicate that no more than slight irritation is likely, unless decomposition products are present, which may result in a greater degree of irritation and possibly sensitization.

CHRONIC EXPOSURE:

DICUMYL PEROXIDE: No data available.

EYE CONTACT:

ACUTE EXPOSURE:

DICUMYL PEROXIDE: Animal tests with a 50% solution in corn oil resulted in mild conjunctivitis, but no corneal effects.

CHRONIC EXPOSURE:

DICUMYL PEROXIDE: No data available.

INGESTION:

ACUTE EXPOSURE:

DICUMYL PEROXIDE: In animal studies, a moderate amount was required to cause death. Symptoms were not reported.

CHRONIC EXPOSURE:

DICUMYL PEROXIDE: No data available.

SECTION 12 ECOLOGICAL INFORMATION

Not available

SECTION 13 DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D003.
Dispose in accordance with all applicable regulations.

SECTION 14 TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101 SHIPPING NAME-UN NUMBER:

Organic peroxide type F, solid (dicumyl peroxide >99%)-UN3110

U.S. DOT 49 CFR 172.101 HAZARD CLASS OR DIVISION:

5.2

U.S. DOT 49 CFR 172.101 PACKING GROUP:

II

U.S. DOT 49 CFR 172.101 AND SUBPART E LABELING REQUIREMENTS:

Organic peroxide

U.S. DOT 49 CFR 172.101 PACKAGING AUTHORIZATIONS:

EXCEPTIONS: 49 CFR 173.152

NON-BULK PACKAGING: 49 CFR 173.225

BULK PACKAGING: 49 CFR 173.225

U.S. DOT 49 CFR 172.101 QUANTITY LIMITATIONS:

PASSENGER AIRCRAFT OR RAILCAR: 10 kg

CARGO AIRCRAFT ONLY: 25 kg

LAND TRANSPORT ADR/RID:

SUBSTANCE NAME: Organic peroxide, type F, solid/Organic peroxide type F, solid

UN NUMBER: UN3110

ADR/RID CLASS: 5.2

ITEM NUMBER: 10(b)

WARNING SIGN/LABEL: 5.2

HAZARD ID NUMBER: 539

AIR TRANSPORT IATA/ICAO:

CORRECT TECHNICAL NAME: Organic peroxide type F, solid

UN/ID NUMBER: UN3110

IATA/ICAO CLASS: 5.2

LABEL: Organic peroxide

MARITIME TRANSPORT IMDG:

CORRECT TECHNICAL NAME: Organic peroxide type F, solid

UN/ID NUMBER: UN3110

IMDG CLASS: 5.2

PACKAGING GROUP: II

EmS No.: 5.2-011

MFAG Table No.: 735

MARINE POLLUTANT: N

SECTION 15 REGULATORY INFORMATION

U.S. REGULATIONS:

TSCA INVENTORY STATUS: Y

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

CERCLA SECTION 103 (40CFR302.4): N

SARA SECTION 302 (40CFR355.30): N

SARA SECTION 304 (40CFR355.40): N

SARA SECTION 313 (40CFR372.65): N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40CFR370.21):

ACUTE: N

CHRONIC: N

FIRE: Y

REACTIVE: Y

SUDDEN RELEASE: N

OSHA PROCESS SAFETY (29CFR1910.119): N

STATE REGULATIONS:

California Proposition 65: N

EUROPEAN REGULATIONS:

EC NUMBER (EINECS): 201-279-3

EC RISK AND SAFETY PHRASES:

R 7	May cause fire.
R 36/38	Irritating to eyes and skin.
S 2	Keep out of reach of children.
S 3/7	Keep container tightly closed in a cool place.
S 14	Keep away from incompatible materials.
S 36/37/39	Wear suitable protective clothing, gloves and eye/face protection.

GERMAN REGULATIONS:

WATER HAZARD CLASS (WGK): 2 (Official German Classification)

SECTION 16 OTHER INFORMATION

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Appendix C

Explosive Hazards Analysis

Impact of a Plastics Plant Explosion on the BN350 Reactor Complex

A Plastics Plant is located approximately 6.1 kilometers from the BN350 Reactor Complex. This plant has a substantial amount of organic peroxides stored under near-ambient conditions in a storage facility. Foam is used for fire protection and suppression and the plant has exhausted its foam supply. A request has been made to provide the plant with additional foam based upon the impact of an explosion at the Plastics Plant on the BN350 Reactor Complex. This paper presents a simplified analysis of potential explosion impacts.

Analysis Scope and Method

The Plastics Plant contains the following hazardous materials:

13.3 metric tons of Benzoyl Peroxide ($C_{14}H_{10}O_4$)
45.8 metric tons of T-Butyl Perbenzoate ($C_{11}H_{14}O_3$)
16.1 metric tons of Dicumyl Peroxide ($C_{18}H_{22}O_2$)

These materials are organic peroxides and represent fire and explosion hazards. To place an upper bound on the explosion hazard, the TNT Model (Center for Chemical Process Safety, 1989) was used. This model can be expressed as

$$Z = R/W^{1/3}$$

Where Z = scaled distance taken from a plot of peak overpressure versus distance, $ft/lb^{1/3}$
 R = radial distance from charge or explosion, ft
 W = charge weight, lb

The Center for Chemical Process Safety (1989) presents plots of peak overpressure versus distance for TNT. Four ranges of peak overpressures are considered in this analysis:

Overpressure	Associated Damage
5.0 psig	Heavy damage to buildings
1.0 psig	Repairable damage to buildings
0.3 psig	"Safe Distance" and projectile limit
0.1 psig	Minimal glass breakage

Analysis Results

It was conservatively assumed that the total inventory of organic peroxides (75.2 metric tons) is equivalent to an equal quantity of TNT. The following results were obtained assuming the total inventory was involved in an explosion.

Peak Overpressure	Associated Damage	Z	W ^{1/3}	R, distance
5.0 psig	Heavy damage	14	55	770 ft (0.24 km)
1.0 psig	Repairable damage	35	55	1900 ft (0.58 km)
0.3 psig	Safe distance	90	55	5000 ft (1.5 km)
0.1 psig	Minimal glass damage	220	55	12000 ft (3.7 km)

Conclusions

Based upon the very conservative analysis performed using the TNT model, no damage would be expected to occur to the BN350 Reactor Complex as a result of an explosion at the Plastics Plant. The Reactor Complex is located approximately 6.1 km from the Plastics Plant. This distance is well beyond the "Safe Distance" of 1.5 km. The potential impact to the Plastics Plant and any directly adjacent facilities is large, but any damage to the BN350 Reactor Complex is expected to be minimal.

References

Center for Chemical Process Safety. 1989. *Guidelines for Chemical Process Quantitative Risk Analysis*. American Institute of Chemical Engineers, New York, New York.

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